# Advisory service support that works enhancing service quality with a mixed-reality system

Dolata, Mateusz ; Agotai, Doris ; Schubiger, Simon ; Schwabe, Gerhard

Abstract: Modern information technology promises to improve service encounters through automated documentation or better decision traceability. At the same time, research suggests a negative impact of technology on human-to-human advisory services: including the possibility that computers might degrade the quality of interpersonal communication and reinforce unpleasant behaviors. Consequently, despite obvious improvements, information technology might have a negative impact on how the participants perceive the service. This might imply serious consequences for the service provider: dissatisfied clients, ineffective information exchange, and/or lack of transparency. This scenario slows down the diffusion of computers into advisory services in banks and insurance companies, and so designing systems for use in interpersonal services remains a challenge. This article provides evidence that LivePaper, a system designed alongside the material practices of a financial advisory encounter, helps to improve important service quality dimensions, making the services not only more pleasant for the participants, but also improving key marketing and business metrics of the service. In experimental advisory services, the sessions supported with LivePaper outperformed conventional services with regard to overall bank service quality and satisfaction, salesperson listening and interaction rating scores, as well as information transparency. This shows that a carefully designed system not only preserves the perceived quality of a service, but might improve it objectively, and has implications for the marketing and business value of the service.

DOI: https://doi.org/10.1145/3415191

# Advisory Service Support that Works: Enhancing Service Quality with a Mixed-reality System

MATEUSZ DOLATA, University of Zurich, Switzerland
DORIS AGOTAI, University of Applied Sciences and Arts Northwestern Switzerland, Switzerland
SIMON SCHUBIGER, University of Applied Sciences and Arts Northwestern Switzerland, Switzerland
GERHARD SCHWABE, University of Zurich, Switzerland

Modern information technology promises to improve service encounters through automated documentation or better decision traceability. At the same time, research suggests a negative impact of technology on human-to-human advisory services: including the possibility that computers might degrade the quality of interpersonal communication and reinforce unpleasant behaviors. Consequently, despite obvious improvements, information technology might have a negative impact on how the participants perceive the service. This might imply serious consequences for the service provider: dissatisfied clients, ineffective information exchange, and/or lack of transparency. This scenario slows down the diffusion of computers into advisory services in banks and insurance companies, and so designing systems for use in interpersonal services remains a challenge. This article provides evidence that LivePaper, a system designed alongside the material practices of a financial advisory encounter, helps to improve important service quality dimensions, making the services not only more pleasant for the participants, but also improving key marketing and business metrics of the service. In experimental advisory services, the sessions supported with LivePaper outperformed conventional services with regard to overall bank service quality and satisfaction, salesperson listening and interaction rating scores, as well as information transparency. This shows that a carefully designed system not only preserves the perceived quality of a service, but might improve it objectively, and has implications for the marketing and business value of the service.

CCS Concepts: • **Human-centered computing → Collaborative interaction;** *Mixed / augmented reality*; Computer supported cooperative work; **Social and professional topics → Socio-technical systems;**

**KEYWORDS**

co-located collaboration; advisory services; pen-and-paper UI; tangible UI; mixed reality; design themes

**ACM Reference format:**

Mateusz Dolata, Doris Agotai, Simon Schubiger, Gerhard Schwabe. 2020. Advisory Service Support that Works: Enhancing Service Quality with a Mixed-reality System. In *Proceedings of the ACM on Human-Computer Interaction*, Vol. 4, No. CSCW2, Article 120, October 2020. *ACM, New York, NY, USA, 20 pages.* https://doi.org/10.1145/3415191

This work is supported by the *Innosuisse – Swiss Innovation Agency*, under grant 17716.1 PFES-ES.

## 1 INTRODUCTION

Advisory service encounters are a form of institutional encounter between an advisor and an advisee oriented toward collaborative search for the best solution to the advisee's problem [41]. Traditionally, advisory service encounters have relied on face-to-face contact between two individuals, the advisor and the advisee, to allow for rapport, impression and trust building [20]. The advisors often use the pencil-selling approach, a direct-marketing technique which relies on hand-made drawings and calculations to visualize the key message and direct a client's attention [20, 28, 62, 73]. However, expectations for advisory services grow continuously: regulators request better documentation and decision traceability [29], while the companies standardize advisory processes and want to link frontline services more effectively to their overall IT infrastructure [57, 70]. Consequently, computers become more and more an element of advisory services and are likely to replace pencil selling soon.

This digital transition bears potential, as information technology was shown to improve such aspects as transparency [58] and knowledge transfer [34]. However, even if carefully designed for supporting advisor-advisee collaboration, computer software was also shown to disturb service interaction and induce ineffective behaviors, such that computer-supported encounters were considered worse than the ones using a pencil and paper [33, 44, 61, 70]. This disruption lowers the value of a service to the client and can have dramatic consequences for the service provider, whose business relies on the quality of advisory services they provide. For many decision makers, it is therefore unclear whether investing in technology for use in advisory services will bring an advantage or a disadvantage. By reporting on experimental evidence using various metrics from service science and marketing, and by explaining the results considering the collected qualitative data, this study shows how LivePaper, a system combining pencil selling with computing can improve a service encounter. This article complements previous research on LivePaper: whereas past research shows that LivePaper induces effective behaviors [15], this study provides evidence that the positive impact is reflected in measures relevant to the service providers.

Companies like banks or insurance carriers are exposed to increasing competition not only among themselves, but also from new FinTech and InsureTech companies [83]. Especially in current times with extremely low or even negative interest rates, which has curbed price competition between service providers, banks explore alternative ways to attract clients and differentiate themselves from the competitors. Many banks possess a dense network of physical branches and trained advisors, which they see as an asset. They try to leverage this asset by offering better customer experience in their retail branches. However, the image of bank advisory services remains negative – since the 2008 financial crisis, many consider advisory services in banks untrustworthy and old-fashioned [6]. Modern technology has potential to help banks improve their advisory services and attract new clients. However, without any evidence that such technology offers an advantage in terms of marketing or business, many companies are reluctant to make adequate investments in it. Similarly, many advisors might be fearful of changes and oppose the introduction of new technologies [70]. This study addresses those concerns by pointing to a range of improvements that come along with the introduction of modern technology to the advisory services at a bank. According to the results, LivePaper-supported encounters are enhancing the client's overall perception of the service quality provided by the bank and make the client more satisfied and more likely to return to the same advisor.

Computer-supported cooperative work (CSCW) and information systems (IS) research has approached various advisory services with prototypical systems. Among the addressed domains are financial service encounters [33, 34, 58], burglary prevention encounters [12, 18, 21, 31] and energy saving advice [30]. However, this research has focused on usability aspects [15, 36], interaction between the advisor and the advisee [23, 33], advisor's work practices [18, 21, 30], and regulatory demands including transparency [58] or knowledge transfer [34]. Whereas those are important aspects and can potentially improve the overall quality of an encounter, it remains unclear whether and to what extent the proposed systems make improvements which justify the expense and effort necessary to build a dedicated system for advisory services.

Also, previous research prototypes, especially those for financial advice, ignored the complex meaning of material and spatial practices between an advisor and an advisee [20]. However, mixed-reality technologies such as tangible [85] and pen-and-paper [75] user interfaces offer ways to incorporate complex material practices into digital support for collaborative work. While the former makes it possible for the user to interact with digital information through the physical environment [40], the latter allows for *"bridging the gap between both worlds by electronically capturing the interactions of a user with a pen and a real paper"* [74]. LivePaper, which follows those design paradigms, was shown to effectively support the pencil-selling practices and to afford new practices compatible with the material rituals during an advisory service, such that the clients experienced the service as stimulating, enjoyable, and still pragmatic, a combination of high-tech and high-touch [15].

This study adds to that research by indicating that LivePaper-supported encounters are likely to change a client's perception of the service quality in various dimensions. This has essential implications for practice and research. Financial institutions receive the long-awaited evidence concerning the impact of information technology on high-level service quality metrics. Designers obtain a set of design principles to guide the

development of effective support for frontline services. Researchers concerned with supporting advisory encounters benefit from a more holistic perspective on measuring the effectiveness of the systems inspired by marketing and service science. Also, researchers investigating the opportunities for tangible and pen-and-paper interfaces receive insights about the niche topic of interpersonal services. This article reports on the evaluation of LivePaper in realistic mortgage advisory service sessions at a bank. The paper contributes towards answering the following research questions:

(RQ1) *How does LivePaper impact the client's perception of the service?*
(RQ2) *Which design elements of LivePaper are relevant to the perception of service quality?*

With reference to RQ1, this article explores the relationship between using LivePaper in an advisory service and the following measures describing the client's perceptions of the service: interaction quality, information transparency, and overall service quality. In doing so, the article attends to the following hypotheses developed in accordance with previous results and the theoretical underpinning of the design (see Section 2.3 for details), and tests those hypotheses in an experimental setting:

(H1) *LivePaper will enhance client's perception of the interaction between himself*[1] *and the advisor.*
(H2) *LivePaper will improve client's perception of information transparency.*
(H3) *LivePaper will enhance client's overall perception of the service quality.*

With reference to RQ2, this article identifies design themes which potentially explain the relationship between using LivePaper and the measured impact. The identified themes originate from the qualitative data collected during the experiment and reflect the observations and opinions reported by the participants in the experiment. The study described in the current article forms a part of a larger research project embracing several iterations of the conceptualization, development, and evaluation of a mixed-reality system for use in financial advisory services with the intention of improving the provision of service.

We follow the lines of *constructive research through design* [47, 84]: The study relies on a description of a real world issue and observations from the field, enriched with the relevant literature, to develop an adequate solution in the form of a collaborative technology. The system gets evaluated against the design objectives with use of acknowledged quantitative instruments and qualitative data. The design objective embraced using a computer-based system to simultaneously improve the client's perception of service quality, while maintaining the interpersonal character of financial advisory services. We *design for practices* [67, 80] by considering the identified and described practices occurring in financial advisory services and by addressing the advisors' rationale behind those practices [20]. We employ acknowledged and popular instruments to measure the changes with respect to the quality of advisory service and collect further opinions from the advisees and advisors. Overall, the study shows that LivePaper use in an advisory service positively impacts the client's perception of the advisor, the service, and the service provider.

## 2 RELATED WORK

### 2.1 Advisory services and advisory practices

Advisory services are a complex phenomenon. From the perspective of the participants, at the micro-level, they are an encounter between two individuals engaging in a collaborative interaction and information exchange [41]. From the perspective of the service provider, they are an offering that should attract clients to establish a lasting commercial relationship with the provider and to use the provider's products [60, 72]. Whereas the former perspective is key to building effective systems for improving advisory services, the latter is important for service providers who consider investing in their advisory services.

At the micro-level, advisory services are institutional encounters between an advisee and an advisor. In the past, they were framed as service transactions [41, 59] or collaborative problem solving [22, 63, 64, 68] – those perspectives were oriented toward the process of an advisory service encounter. However, recent studies acknowledge the practices and social rituals rather than the process as the foundation of successful advisory service [16, 18–21, 77], thus aligning with the research on institutional talk [26, 32]. This view sources from Schegloff's [66] view of conversation as highly routinized achievement between two interlocutors, and Scollon's [71] argument that practices are not only situated in the intermediate context of an action, but also in a broader, social context – a person's actions embrace their general social, organizational, and political standing as well. For instance, it has been shown that bank advisors employ paper and pen in specific ways to influence what the advisee thinks of the advisor or the bank, i.e., they engage in impression management [20]. To that end, they employ pencil selling – a widely-spread direct-marketing technique

[1] In order to guarantee for the gender balance, while keeping the manuscript easy to read, the advisor is referred to as a female (she, her) and the advisee is referred to as a male (he, his, him),

involving the use of pen and paper as core tools during a service to transfer information and manage the client's attention [28, 62, 73]. An advisor would rather engage in such material practices than overtly advertise herself or her bank. However, impression management goes beyond the simple application of pencil selling: while pencil selling focuses on what is drawn or written on paper [28, 62, 73], advisors deliberately use the physical nature or positioning of paper as well [20]. Social rituals like adequate greeting, courtesy, or small talk, play an equally important role [15, 23] – advisory services rely on a shared understanding of social roles and scripts [27, 76]. This has implications for the design of information technology to be used in advisory services. Whereas the transaction or problem-solving view focused on how specific tasks should be addressed in a tool and in which order [44–46], the institutional talk perspective stresses the role of technology as a support for social interaction.

Designing for social interaction is a difficult challenge. Reports on negative or double-edged effects of digital support on the interaction in advice-giving [19, 22, 44, 45, 70] dominate over those that show technology's positive impact [12]. This holds true specifically for financial service encounters. Many prototypes were creating significant disturbance of the conversation [44], enforced ineffective and unnatural behaviors [46], impeded the relationship-building [33], or raised irrelevant questions [45]. Even though using a computer has potential for streamlining the service process [57], enhancing knowledge transfer [34] and transparency [58] by introducing a shared visual medium, the diffusion of computers in advisory services is slow and driven by banks' management rather than frontline employees [70]. However, recent research in this domain paves a way for a new generation of systems for advisory services. Those systems acknowledge the role of social rituals and material practices by combining digital data processing and visualization with paper, pen and new tangible elements – such systems were shown to afford practices resembling the natural conduct in financial advisory services [15, 23]. In particular, LivePaper enables the combination of the high-touch character of a financial advisory service with the advantages of high-tech processing and information visualization [15].

While the effective combination of high tech and high touch is a very important and large step for the research concerned with technology in frontline services, it is not enough. Frontline personnel still lack evidence that using the system not only preserves useful practices or makes the service more enjoyable, but indeed improves the client's perception of the interaction during an advisory service. Since the advisors are very cautious of what impression they make on the client and want to make sure that the client perceives them as trustworthy and organized, while at the same time a forthcoming and likeable person [20], they will use the system only if it offers a chance to improve in this regard.

The macro-level perspective on advisory services deals with their business value. Financial institutions have offered individual advisory services for decades. They are mostly free of charge for the client and should attract his attention to specific products (loans, deposits, investment schemes) [59]. According to this perspective, advisory services are essential for marketing purposes. However, as opposed to other economy sectors and other marketing channels, financial advisory services are regulated and audited [60]. This control should guarantee that the client can trust his bank and his advisor. Since the 2008 crisis, many countries have implemented rules under which a bank might lose its banking license if it offers dubious or unreliable advisory services [50]. Consequently, banks are very careful concerning any changes in their advisory services, especially in terms of technology [2]. At the same time, the competition among financial institutions forces them to improve their advisory services as a way to attract clients and get them to choose a product from the bank's portfolio. It has been repeatedly shown that a client's perception of bank service quality has a direct impact on the client's intention to use products of that bank and to establish a long-lasting commercial relationship with the bank [1, 78].

Designing systems at the intersection of marketing and regulatory demands concerning information transfer, and the interpersonal character of an encounter is challenging. Earlier research has focused on the information transfer framed as as the client's education [34] or transparency [58] and designed systems to help fulfill those requirements. However they were controversial in terms of marketing or generated issues concerning relationship building [33, 35]. Later on, research yielded systems that included notions from marketing, like customer orientation, and supported marketing activities like profiling [43]. However, they created severe problems around the interaction between the advisor and the advisee [45, 46].

Generally speaking, the systems could not be shown to improve the overall satisfaction with the service nor were they shown to lower this satisfaction. Thus, including them in real advisory services would have been a risk [43]. LivePaper builds upon the insights from earlier research by providing visualizations for client education, thus addressing the regulatory requirements concerning information transfer, or by introducing personal content into the conversation, thus enabling marketing activities (cf. Section 3.1). This innovation has been shown to stimulate the client and enhance the information flow [15]. LivePaper adds to that by considering the interpersonal character of the encounter and enabling practices related to the interpersonal relationship [15]. However, previous research makes clear that improving the interpersonal relationship in isolation from other important aspects does not suffice to enhance client satisfaction either [4, 81]. Consequently, it remains an open question whether LivePaper's support for the combination of information transfer, marketing and relationship activities suffices to make the client more satisfied overall with the quality of the advisory service provided by the bank.

## 2.2 Interfaces between the physical and digital world in advisory services

Computer science, especially human-computer interaction (HCI), has studied ways of enabling natural interaction with computers. This research promises to combine material practices with powers of a computer. The relevant efforts flow into a range of mixed-reality discourses: Augmented reality (AR) studies how to overlay physical spaces with computer-generated content [5, 7]; spatial AR projects directly into the environment of the user [8]. Organic user interfaces (OUI) focus on using non-planar spaces that function as means of input and output, such that a user can interact with them through bending, folding, and manipulating the form – this includes using paper as display [37, 38]. Tangible user interfaces (TUI) focus on enabling interaction, manipulation, and collaboration [69] with digital content through physical objects and space [40, 85]. Finally, pen-and-paper user interfaces (PPUI) bridge the gap between digital interaction and the paper [49, 74, 75]. All those tools share a focus on expanding one's experience of the physical world with digital content and functionalities. To a certain extent, they want to turn the user's focus and attention away from the computer and back to the physical world, thus allowing for *calm design* [79], in which the technology provides information or enhances the experience, but does not compete for the user's attention and stays in the periphery until needed. Each discourse offers numerous ideas on how a support system for an advisory service could be designed and what it would look like. LivePaper uses concepts from spatial AR and OUI to allow for use of paper as a shared medium and table as a projection space, employs insights from PPUI to provide a pen as an input device, and drives inspiration from TUI to introduce further tangible elements for interaction with the system.

Mixed reality solutions have been employed in a wide range of domains to offer the user new forms of experiences. There is a wide range of playful applications involving single und multi-player games using this paradigm to enable more immersive experiences [3]. Some applications leverage mixed realty for serious gaming and gamification of training, which combines cognitive and physical interaction [39]. Nevertheless, there is also a range of professional applications based on mixed reality used, among other fields, in architecture, marketing and education [7]. In the context of architecture and design, augmented reality solutions are employed to make models of buildings easier to experience and evaluate; in marketing, mixed reality solutions are used to enhance the customer experience by integrating specific effects into brick-and-mortar stores or by allowing the client to try on clothes virtually [7, 9]. Finally, in education and training, mixed reality allows for multidimensional and interactive representation of complex phenomena [13, 42, 69] and for representation of complex processes [14, 51]. Multiple studies show that applications using mixed reality make teaching more effective and engaging [42]. In particular, mixed reality allows for representation of and interaction with otherwise invisible or hard-to-grasp elements (e.g., forces in physics classes) [42]. Similar concepts could be employed in financial advisory services to educate the client about complex bank products or monetary relationships.

Despite the ongoing diffusion and potential, the use of mixed-reality in co-located frontline services like advisory encounters remains limited. However, we claim that mixed reality also can be used to address another problem in professional services: the accountability and understandability of action. In an advisory service, the activities of one party, the advisor, need to be accountable to the other party, the advisee, such that the action can be properly interpreted within the proper context [24]. Otherwise what the advisor does with the provided information and why will be obscured from the client [58]. Inability to interpret an action will lead to irritating misinterpretations which require attention to get resolved [45]. For instance, if an advisor needed to tap three times to launch a specific computation (even if this interaction seems easy), the advisee could end up focusing more on resolving the meaning of the interaction rather than on the content [24, 25]. Accountability supports the advisee in understanding the content itself: with natural and visible data manipulation techniques, the advisee is more likely to understand the impact of specific actions on the financial situation or its representation [34]. However, the meaning of the actions is understandable only in the context of the interaction. The context of an advisory service consists of the physical environment (e.g., light, professionally looking rooms and furniture), tools used throughout the service (e.g., paper, pen, calculator), and social rituals and scripts typical for institutional talk (cf. Section 2.1). Advisees interpret visible actions in light of a set of shared expectations concerning the context [17]. The various mixed-reality approaches make it possible to preserve the tools and environment typical for an advisory service in a bank [74]. LivePaper leverages those insights by using tangible manipulation and visualizations for accountable actions, while simultaneously preserving the context.

Mixed reality discourse offers approaches with great potential to fit the context of service encounters. It provides ways to keep the existing material practices largely unchanged; it provides ways to make the advisor's actions more accountable to the client than standard user interfaces are. Nevertheless, mixed reality has not been deployed yet in professional advisory services at a large scale. One reason might be that it is simply unknown how the clients will react to this sort of computing: in particular, financial service providers are very cautious not to introduce innovations which may disturb their relations with the client. In short, they lack evidence for the positive impact of mixed-reality systems on the client's satisfaction with the service. This article tries to close this gap and pave the way for a broader use of mixed-reality UI in advisory services.

### 2.3 Research Hypotheses

The developed hypotheses consider the past results concerning the impact of LivePaper on the encounters as well as more general discourses on the support of advisory services and on the impact of mixed-reality on collaboration. Previous research has shown that LivePaper facilitates specific social rituals like greeting and welcoming [23] or introduction of a new topic into an ongoing conversation [15] and extends them to the material and physical space [15, 23]. Additionally, the research on social rituals suggests that engaging in a ritual has a positive impact on the sense of cohesion among the participants and the physical dimension intensifies the ritual [11]. Based on this research, we hypothesize that (H1) *LivePaper will enhance client's perception of the interaction between himself and the advisor.*

The research on information transfer in collaboration, and specifically in service encounters, indicates that a successful cooperation requires the action of one party to be understandable to the other party [24, 25, 58]. Systems for advisory services without specific support for such awareness were shown to confuse the client and disturb the service [45, 46], whereas those improving transparency had a positive impact on the overall client's satisfaction [58]. Also, literature on client education in advisory services suggests that facilitating a multisensory experience, rather than using abstract explanations or examples, helps clients understand financial matters significantly better and likewise, to understand the actions and explanations of the advisor better, as well [34, 35]. Mixed reality has been employed in educational contexts, where it was shown to improve the understandability of abstract concepts by providing dynamic and tangible interactions [7]. LivePaper combines the potential of mixed reality with earlier design guidance on information transparency and on the role of experience in client education [15], which lets us hypothesize that (H2) *LivePaper will improve the client's perception of information transparency.*

The research on technology support for financial advisory services teaches us that addressing information transfer (client education, transparency) or marketing (profiling, cross-selling) aspects of an advisory service in isolation does not suffice to improve the client's satisfaction with service quality [35, 45, 58]. It also points to the relationship and relationship building as the third aspect that impacts overall satisfaction [33], but makes clear that focusing on relationship only does not suffice either [4, 81]. LivePaper was shown previously to enable marketing activities and thereby stimulate the client as well as improving their identification with the service [15]. Additionally, the current paper claims that LivePaper enhances information transfer (H2) and enhances the relationship between the advisor and the advisee (H1). Given that LivePaper's design addresses the combination of information transfer, marketing, and relationship aspects, we hypothesize that (H3) *LivePaper will enhance client's overall perception of the service quality.*

## 3 DESIGN AND EVALUATION

### 3.1 LivePaper

This study was conducted as part of a larger research project involving researchers from two universities and a local bank. The project aimed at designing a system, LivePaper, to help the local bank improve their advisory services. Conventional advisory services are sub-efficient: they require extensive pre- and post-processing to produce adequate documentation and they involve extensive manual calculations during the provision of service if the advisee deviates from the scenario prepared by the advisor. Their effectiveness relies strongly on the relationship and quality of conversation between the advisor and the advisee, which may decrease if the advisor must make many calculations during the encounter or cannot rely on the prepared material. The financial advisory services, which involve using a traditional computer and a shared screen, are sub-effective because the computer disturbs the rapport building and natural conversation. Consequently, the design objective in the project was to connect the interpersonal character of a conventional mortgage advisory service encounter with the functionalities of a computer (e.g., quick calculations, dynamic visualizations, and seamless documentation). This particular study was conducted to analyze the impact of LivePaper on the client's perception of the service according to the interest of the service provider (satisfaction, interaction quality, transparency).

Existing advisory practices involve extensive and diverse use of paper and printed materials positioned on a table between the advisor and the advisee [20]. LivePaper [15] keeps pen-and-paper as the basic interaction material: the medium which has been used for interaction between the advisor and the advisee (through writing and gestures) gets augmented in a way that complements existing tools with computer-generated visualizations. LivePaper supports behaviors involved in use and manipulation of sheets of paper in a way that allows for input and output to and from the digital backend.

To allow for output of digital content to paper, the system uses projection, with the Optoma UHD60 4K projector positioned above a table. There are two channels of input: (1) position, size, movement and rotation of the paper and a paper pad, as well as the position of the participants' hands through a Microsoft Kinect sensor mounted next to the projector; and (2) handwriting and drawings on the paper are captured by the Wacom Bamboo Slate and then processed with a handwriting recognition module from Microsoft to identify

text. Inputs from the infrared camera are interpreted by the system to identify the actions of the users (changing position, choosing a projected item by clicking). Recognized text input gets digitalized, and as soon as the system recognizes a specific *code word*, the subsequent content gets stored as a value of a predefined variable (e.g., net assets). The current list of code words mirrors the advisors' shortcuts used during conventional advisory services (e.g., "*EM*" for *Eigenmittel*, German for *net assets*). Other inputs from the pad are stored as unformatted text and are not processed by the system anymore; of course, they also stay on the paper in form of ink. Fig. 1. lists the core ideas behind the design of LivePaper and Fig. 2. features scenes of LivePaper in use. Overall, the system offers means that reflect the interaction material from traditional encounters – it affords practices and rituals typical for the interaction in financial advisory services.

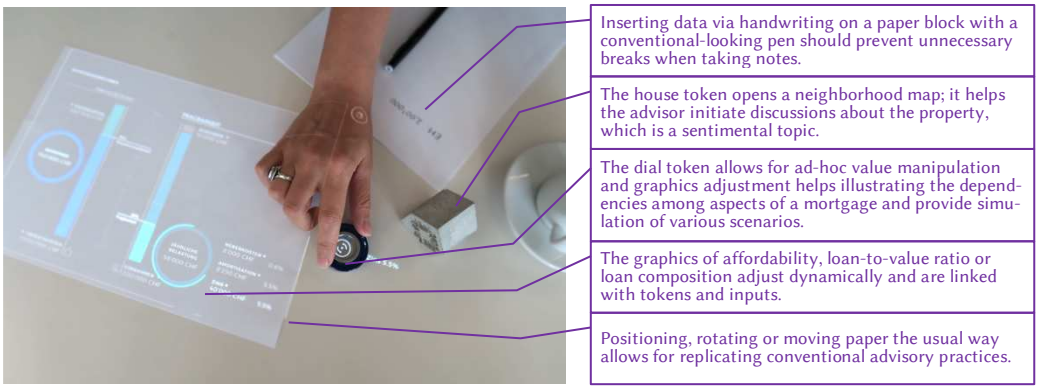


Fig. 1. The overview of interaction means included in LivePaper for mortgage advisory services [15]

Using this infrastructure, the advisor can engage in all behaviors typical for conventional advisory services: she can put several sheets of paper next to each other to compare their content; she can put the sheets of paper on a pile to return to them later; she can take notes and draw like she is used to doing; and she can position, re-position and turn sheets of paper [20]. However, those behaviors can be digitally enhanced: thanks to the marked paper and projection, the sheets of paper can be used for projection of digital content (dynamic visualization of loan-to-value ratio, affordability, and composition of a loan), she would otherwise tediously draw and calculate. Like in a conventional session, the content is linked to a particular piece of paper; the system remembers which content was projected on which sheet of paper, such that the paper can be moved off the table, put on a pile, or turned upside down, but as soon as the system recognizes it, the content returns too. By withdrawing a sheet of paper from the table, the advisor can clean up the space and conduct the encounter in an orderly manner. Overall, LivePaper supports typical advisory-services behaviors and adds features that bridge the physical practice and digital representations by adding digital overlay or by analyzing analog input (writing, moving, turning, pointing to select).

However, LivePaper goes beyond known practices and offers additional ways for interacting with the system, which were not possible in the conventional setting. Those new functionalities enter the interaction as "tokens" – small, 3D control units, adapted to fit mortgage advice services. A *house* can be positioned on the table to open a projection of the map showing the location of the property the advisee is going to buy with the mortgage. Adding a *chip* to a mortgage changes the composition of the loan, such that the advisor can combine fixed-rate and flexible-rate mortgages by adding and removing chips, thus visualizing this procedure to the advisee. Finally, relevant numbers can be adjusted easily with a *dial* for simulation purposes. For instance, if the advisee wants to check an alternative scenario that involves reduced net assets, monthly income, or growing interest rates – the output variables such as affordability, loan-to-value ratio, etc. adapt automatically. Consequently, LivePaper affords additional, new practices consistent with the rationale behind advisors' existing material practices.

Overall, LivePaper combines several mixed-reality paradigms. The system augments real spaces and objects (table, sheets of paper) with digital content such as that found in spatial AR [5, 7, 8]. The augmented visualization is extended through interactive elements: the user can use their fingers for 'touch' input (e.g., selecting values to be manipulated) on the paper also that can be bent and re-positioned (cf. OUI [37, 38]). All sheets of paper can be used for inking, and writing on a paper positioned on the pad even gets recognized and digitalized; both participants can place any other piece of paper on the table without causing unintended interaction with the system. This enables the usual application of paper and pen during the advisory service, as well as interaction with the system via paper when intended (cf. PPUI [49, 74, 75]). Tangibles extend the interaction possibilities beyond the pen and paper and enable novel interactions in advisory services: rotating a dial changes selected mortgage values, tranches of a mortgage are represented as chips, and a small

house represents the property (those interactions follow the lines of TUI [40, 69, 85]). In LivePaper, a sheet of paper can simultaneously serve as a projection space, a touch interface and a space for ink input, while remaining a tangible and spatial resource that can be freely repositioned, as well as moved away from the active interaction zone on the table. This allows for bridging between the digital and analog world via paper [48, 49].

Fig. 2. The system in use during an advisory service: Left: side view. Right: top view [15]

### 3.2 Evaluation design

The LivePaper was instantiated with all features presented above to support mortgage advice services at a regional, Swiss bank with 13 branches and approximately 400 employees, who serve an area inhabited by about 600,000 people. In the remainder of this paper, we refer to this bank as MoBa (*mortgage bank*). Two members of MoBa's management body joined the project steering committee, consisting of four senior researchers from two Swiss universities. Additionally, MoBa's advisors provided regular feedback during workshops and formative tests concerning the system's usability and formal, content or calculation issues.

The evaluation, providing results for the current study, tested the first functional version of LivePaper. This evaluation was conducted in a MoBa branch in January and February 2017 and was arranged as a within-subject design experiment [53]. We compare LivePaper services against conventional advisory services, where no or only very limited technology is used (e.g., calculator). Choosing a conventional setting as a baseline has the following rationale: first, prototypes for financial advisory services depicted and evaluated in past research often had a negative impact on service quality [44, 46] or had no significant influence [34]. Therefore, we chose a baseline that is potentially harder to beat. Second, the conventional setting reflects the advisors' current work practice, thus giving the client the chance to compare settings with an intervention (LivePaper) and without it. Finally, an alternative experimental design, in which LivePaper is tested against another system for financial advisory services, would require training the advisors for use of the alternative system as well, thus involving more resources. Comparison against the conventional service allowed us to identify themes relevant to the design of technology for advisory service support.

Each subject passed through a conventional and a LivePaper-supported advisory service. They experienced the system in the intended use scenario, i.e., during a mortgage advisory service between a potential client and a professional bank advisor and could compare it to the conventional situation. This enabled an understanding of the positive and negative impacts of LivePaper on the advisory service. Six selected advisors, other than those who participated in the development process, were chosen for this evaluation. They received a half-day of training on the usage of LivePaper – during the training they learned about the system functionalities and simulated an advisory service with a colleague. A few days later, during the evaluation, each advisor advised three different test clients while providing one conventional and one LivePaper advisory service to each of them. To balance out the order effects, we varied the arrangement of treatments. The 18 test persons acting as advisees were recruited through advertisement on the official website of the university, available to the broader public and linked with social media. They were offered a compensation of 60 CHF (approx. 60 USD) for 2.5 hours. On average, the subjects acting as advisees were 27.5 years old, with the youngest participant aged 20 and the oldest one - 49. Their professions included, among others: shop assistant, nursery teacher, designer, and veterinarian assistant; 7 participants were students from various fields and universities. All declared an interest in the topic because they considered buying a property or have experience with mortgages. They were provided a rough handout including information on their test financial situation, on the property they pretend to buy, and a few questions often asked by advisees in real sessions. However, the advisees and the advisors were free to proceed any way they wanted during the

encounter – some conversations deviated from the handout depending on the content. Fig. 3. illustrates the evaluation design.

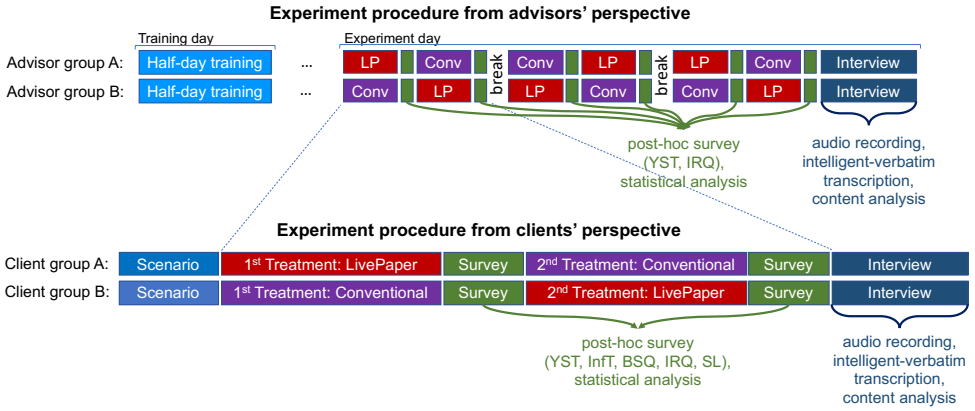


Fig. 3. Experiment procedures from advisors' and clients' perspectives with data collection and analysis activities during and after the experiment

During the experiment we employed various measures to assess the impact of LivePaper as perceived by the client. We chose measurements to reflect the hypotheses listed in Section 2. To assess the impact of LivePaper on the interaction between the client and the advisor, we employ two instruments: (1) Previous research has attributed disturbed communication to technology used in advisory services. Given the importance of interpersonal conduct in service encounters, understanding whether LivePaper impacts the client's judgment of the interaction's conduct was core. To assess whether the participants enjoyed the conversation and what their comfort level was during the service, we employed the *interaction rating quality* (IRQ, [55]). It was originally developed in the context of linguistic studies to measure whether the participants experienced a particularly engaging interaction with the opposite party and whether they "clicked" with each other. It consists of items measuring, primarily, the subjective sense of relationship to the conversation participant. (2) Past research pointed to the fact that technology might reduce the responsiveness of the advisor and generate the impression that she would not listen to the client [44]. To measure explicitly this aspect, we use the *salesperson listening scale* (SL, [65]) consisting of six subscales addressing sensing, evaluating, responding, trust, satisfaction, and anticipation of future interaction. (Does the client intend to contact the same advisor again?) The scale was developed in a rigid process and has been widely used, primarily in marketing research (over 500 citations). While IRQ measures the general impression of the interaction, SL focuses strongly on how well the advisor reacts to the interaction from the client. If a bank can use LivePaper to improve interaction between the advisor and the advisee, it can reduce the risk of misunderstandings and give the client the feeling of being listened to.

To assess the impact of LivePaper on the client's overall satisfaction with the service, we employ two instruments: (1) Advisors define a satisfied client as an ultimate goal of their job [20], but often lack feedback on how they can achieve it. Consequently, measuring the impact of tools used in an advisory service on the overall satisfaction of the client is an important signal for the advisor who might be lacking confidence in interaction with technology. We measured client satisfaction with a measurement developed in accordance with *yield shift theory* (YST, [10]). YST relies on the assumption that a positive shift towards the achievement of a goal produces a positive satisfaction response. YST has been used in over 50 studies, mainly in information systems research. (2) For the banks, it is important to understand the impact of a system on the perception of service quality overall. *Bank service quality* (BSQ, [1]) is an instrument developed in a rigid scale development study and is intended to capture all aspects relevant to service quality of a bank. It has been used in ~ 100 studies around the world. The instrument was developed in alignment with SERVQUAL, the most popular service quality measure. BSQ measures over 30 items and addresses such aspects of financial services as systemization, responsiveness and communication. If a bank can use LivePaper to make the client more satisfied with its service, they can expect better word-of-mouth marketing and higher retention rates for clients.

Finally, we assess the impact of LivePaper on the *information transparency* (InfT) by using a single instrument proposed earlier for application in the context of financial services [58]. Information transparency has been identified as a core aspect of financial services and TUI/PPUI solutions promise to enhance information transfer in collaborative settings. The instrument used in the current study consists of three items using a 5-point Likert scale and asks the client about his understanding of how the data collected from him

relates to the data provided by the advisor. If a bank can show that they use a system which enhances transparency, it can demonstrate that it makes improvements to comply with regulatory demands.

Even though the study focuses on the experiences of the clients and how they perceive LivePaper's impact on advisory services, we also asked the advisors to provide their assessment of satisfaction (YST, [10]) and of the interaction with the client (IRQ, [55]). Each advisor completed the survey after each session, such that we obtained 36 measurements for each construct – 18 regarding conventional and 18 regarding LivePaper treatments.

In addition to the questionnaire-based measurements, the subjects participated in an interview after the last treatment. That is, the clients participated in an interview after the second treatment and the advisors participated in an interview after conducting six advisory services with three different clients. The interviews with the advisees took ~ 30 minutes and the ones with advisors ~ 60 minutes. The interviews were structured around the experiences of the participants (most enjoyable and least enjoyable episode from the advisory services), as well as the overall impression of the advisory service and its phases. All interviews were transcribed by an external transcription service according to the intelligent verbatim standard. The transcribed interviews were coded by the first author under regular supervision from the last author according to the bottom-up, iterative procedure. In particular, the first round of coding focused on the identification of the most prominent differences between the conventional and LivePaper services as perceived by the interviewee. Often the interviewees were directly describing an episode in one of the treatments and pointed out the lack of a comparable episode in the other treatment. In the second round of coding, the focus was on which of those differences relate to what design decisions. The goal was to identify themes that describe the impact of information technology on advisory services. Overall, the design experiment evaluated LivePaper in a realistic scenario while collecting multiple measures concerned with the impact of LivePaper on the quality of service.

## 4 RESULTS

### 4.1 Feedback from advisees

Advisees' feedback shows LivePaper-supported services perform significantly better than conventional ones on most of the measured dimensions. The general satisfaction (YST) and BSQ (Fig. 4) show enhancement of the perception of general service quality (H3). Improved InfT (Fig. 4) confirms that LivePaper indeed improves information transparency (H2). IRQ and SL (Fig. 4) illustrate improvement regarding the interaction between the advisee and the advisor (H1), even though not all SL scales show a significant difference: while satisfaction and anticipation are significantly better in the LivePaper setting, other dimensions of SL (sensing, evaluating, responding and trust) remain stable between conditions - this is consistent, as most relevant advisor behaviors do not change between the settings. Table 1 provides an overview of the conducted significance tests for the measures with significant differences between the treatments.

Table 1. Summary of significance test results for the selected measurement instruments. Differences with strong significance ($p<0.01$ in a two-tailed, paired t-test) are marked in bold.

| *Measurement (points on Likert scale)* | *LivePaper - Mean* | *Conventional - Mean* | *Increase by* | *t(17)* | *p (two-tailed, paired)* |
|---|---|---|---|---|---|
| Satisfaction, YST (5) | **4.44** | **3.89** | 14% | 3.01 | 0.008 |
| Information Transparency, InfT (5) | 4.52 | 4.20 | 8% | 2.52 | 0.022 |
| Bank Service Quality, BSQ (7) | **6.05** | **5.46** | 11% | 5.03 | 0.000 |
| Interaction Rating Quality, IRQ (5) | 4.19 | 3.96 | 6% | 2.29 | 0.035 |
| Salesperson Listening - Satisfaction (7) | **6.50** | **5.93** | 10% | 4.56 | 0.000 |
| Salesperson Listening - Anticipation (7) | 6.43 | 6.02 | 7% | 2.08 | 0.050 |

In the interviews, the advisees relate their assessment to several themes. A central and returning theme is the comprehensive character of LivePaper advisory services. The collected opinions attribute the better understanding to the illustrations provided with the LivePaper, but also to the fact that they can be dynamically adjusted, for instance, with the dial (called "screw" by some advisees). The gestures involved in adjusting the values support the comprehensive character of the services and encourage the clients to ask questions: *"[I liked] both, the presentation, but also the dynamics, because he was able to turn the screw directly, and then the graphics have adapted accordingly. That's just better to be understood than as if someone, let's say, makes arrows on the sheet of paper (…) It is easier to understand. (…) One just had a better overview and could track the connections between things, how they affect each other. I also had the heart to ask how it would change with 80% of income, because he would not have to enter everything again*" (Client 17). Dynamic visualizations

in combination with the tokens was identified as a significant design aspect contributing to the understanding of complex financial matters and transparency. In fact, visualization and understanding were the two codes most often identified in the interviews and there was a strong overlap between the two aspects.

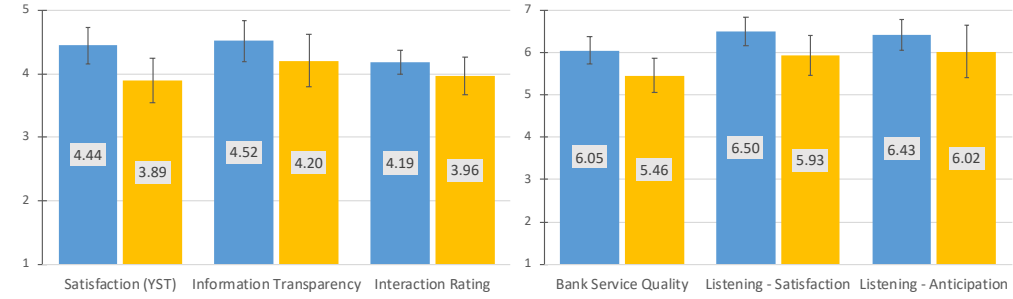


Fig. 4. Average advisees' assessment of the advisory settings for the selected measurement instruments (blue – LivePaper, yellow – conventional, error bars: 95% CI). Max and min values are given on the y-axis.

Advisees also preferred the closure phase of the service, when the advisor summarizes the encounter, to be conducted with LivePaper: "*It's easier. You just see a little structure, so on the side, you see now the data about my person, and about the house that I want to buy, and about my person and income, and then the portability is calculated (…) then the compilation of everything*" (Client 10). They acknowledged the fact that the clear structure supports orientation throughout the encounter, but did not have the feeling that they are forced to follow this structure: "*[Interviewer: How about structuring the encounter?] [Interviewee:] Yes, that was more the case with LivePaper because he had those points. First with the mortgages and then with the mortgage mix. (…) With the paper, so in the normal consultation, it was not clear to me at which point we are. I did not know: Is this mix coming or not? And then, as he continued, I thought, Okay - probably not. But with LivePaper, I've seen that something is coming. I found that better with live papers. [Interviewer: Did you have the feeling that you have to follow a structure?] [Interviewee:] It did not seem to me directly predetermined*" (Client 15). The clients value the clear and comprehensible structure of the service with LivePaper introduced by the comprehensible cutover points signalled by changing the sheets of paper.

Apart from LivePaper's potential for making the interaction clearer and more welcoming, advisees acknowledge that introducing side topics through design, e.g., location of the property, eased the atmosphere and made the interaction more enjoyable: "*In the first, conventional conversation the property was just there. In the second conversation it was nice to see: 'Ah the real estate is there.', I had already seen it. (…) He said: 'Look, Mr. Weber, here is your object, that is your neighborhood' – he showed interest and we could discuss it*". Many advisees confirm that discussing the property made them feel that the actual, human reason for having the encounter moved into focus. However, some advisees miss a better link to the overall goal of the encounter: "*I thought it was nice as a start. Well, I liked that he was interested in where it is. It would be a good start. But, if it had a connection to the rest of the conversation, it might be better*" (Client 16). By using tokens with sentimental value to the client, LivePaper helped the advisor make an impression on the client and entice him, but some clients are cautious and wary of subliminal influence.

Advisees also noticed that LivePaper turns back the advisor's attention to the advisee and the communication: "*When he was using the calculator and his sheets, and was about to work something out, I knew, I probably could not talk to him at that moment. When he was using the LivePaper, he had the same basis as me. He did not have to concentrate on the inputs, but he knew that he can adjust the numbers and the system calculates for him. It gives him the opportunity to explain what is happening (…) and talk to me*" (Client 16). The natural input, explicitly pen input, combined with the background calculation was identified by many informants as an improvement compared to conventional service, in which the advisor used calculators or a spreadsheet application.

Given the positive reception of LivePaper, we tried to get the advisees to reflect on whether a tool like this may be used to fool a potential customer. Most advisees argued against this risk: "*I think as a customer, I'm already aware that the consultant wants to hear my interests, but primarily he actually stands for the bank (…) Well, the customer has a great deal of responsibility for what he wants and how he wants it. (…) With LivePaper, I think you could adjust everything, and you could simulate different scenarios and it was better there, clearer. And you have the numbers all in front of you and so you felt more confident, because you had everything in front of you, with simulations and you could compare. And in the conventional case, it was, maybe, a maximum of 20 words or just with the numbers there. And yes, that was just too little to somehow create the same confidence as in the LivePaper*" (Client 11). Overall, the advisees see the advantages of LivePaper for better understanding and transparency, clearer but non-enforced structuring of the encounter, joyful or engaging elements, and better contact with the advisor. They attribute those advantages to visualizations and tangibles, but also to the way those elements get embedded in the practice.

### 4.2 Feedback from advisors

Advisors' feedback is not as enthusiastic as that from advisees. Measures do not provide significant results and means differ by less than 0.1 on a 5-point Likert scale. Accordingly, the measure of satisfaction remains stable, on the rather high level (YST: 4.30 for LivePaper vs. 4.23 for conventional). The IRQ does not yield significant differences either (3.93 vs. 4.03 from 5). Nevertheless, when asked which of the advisory settings they would prefer, four advisors clearly prefer LivePaper and only two are indifferent; none of them chooses the conventional advisory service. Overall, advisors primarily see LivePaper's potential for addressing advisees' feelings as an essential element in high-touch services, but do not notice differences going beyond that.

The general tone sees LivePaper as helpful if it comes to structuring the encounter, but the structure should be adequate, so that the advisors can identify with it: "*I think there is a clear thread through the encounter [with LivePaper]. In classical services, you have more breaks and, depending on how you designed it, the clear thread is not always recognizable. By contrast, with LivePaper, the structure is clearly recognizable. Which property is it? (…) And then you come to the different models you can show. But you are more tied to the process. In the classic model, on the other hand, you are more flexible. (…) It is not like I felt forced to follow this process. I did not feel urged. I think that LivePaper offers a clearer structure, especially in the end. Beautifully targeted, chop-chop-chop. I did not have to pretend (…) it felt natural to me*" (Advisor 4). Most advisors refer to the structuring theme and see LivePaper as helpful, but they also require the structure to be flexible enough to accommodate their specific practices.

Additionally, the advisors value the opportunity to address directly the personally meaningful and sentimental content with LivePaper: "*In trainings, one gets taught to focus on emotions. (…) [The house token] is a good start, because, in my opinion, your [client's] thoughts are with the house at that moment. With LivePaper you can better imagine it and everything. If you just start talking and messing around with numbers, that's certainly not a pleasant start, as if you visualized it*" (Advisor 6). The advisors like the idea of using meaningful tokens to engage better with content that is important to the client. However, the advisors are also aware that impression management, i.e., influencing what the client thinks about the advisor herself or about the bank, remains an issue with LivePaper too; they stress that making the right impression might become even more important, because the client's attention is divided between the system and the advisor, thus leaving less time for impression management: "*I think, if you use the system, the first impression of the consultant is even more important than if you make it the conventional way. Because the client focuses already more on the system than on the advisor herself. So, if he's focused on her, this moment gets just more important. Yes… but I think it can also be cool*" (Advisor 1). Overall, advisors explain their assessment against the backdrop of their daily practice rather than as a standalone experience and acknowledge LivePaper's positive impact on the interaction.

Analysis of the interviews makes clear that the advisors try to assess the potential of LivePaper against their practice experience, thus providing a differentiated picture. An advisor makes clear that she needs her freedom to choose the right advisory service tools: "*I think, the new consultation with the LivePaper – so, I really loved it and as I said, I'm open to it, if it generates added value. It felt very well. Sure, one will always have handling issues at the beginning. That takes a few times until one is well versed in it. But I think if you have a target, it can be a good thing. It also depends on who you are sitting in front of you, if you have an Italian customer, or one of a different nationality, or even German, then it will be difficult. Then, I need the freedom of switching to the classic version*" (Advisor 4). This statement suggests that advisors fear reduction of their freedom if new systems get introduced. While this is not entirely a design issue, this theme is relevant for the designers of the systems for advisory services. LivePaper tries to accommodate it by using the standard wooden table and the standard sitting position – if the advisor decides to conduct the advisory service the conventional way, the client will likely not even notice that there is technology in the room.

## 5 DISCUSSION

The results show the impact of LivePaper on advisory service quality: LivePaper outperforms conventional advisory service with regard to a client's perception of the service quality (H3), client's perception of the interaction with the advisor (H1), and client's perception of information transparency (H2). Some improvements exceed 10%. This suggests that LivePaper is an effective instrument for enhancing the value of advisory services. The analysis of the interviews unveils why this is the case: First, there are specific elements of the design pointed out by the informants and presented below in form of design themes. Second, LivePaper leverages existing practices and rituals rather than trying to change them. The following section discusses both aspects of LivePaper's positive impact.

### 5.1 Key design themes for improving services

With regard to the interpersonal character of the service encounter, the evaluation results demonstrate that information technology does not have to disturb the interaction between the interlocutors or de-humanize

the encounter, as it was suggested in past research [43, 44, 46]. On the contrary, LivePaper contributes to the advisee's satisfaction with the interaction while enhancing the perceived service quality as well. This sets this study apart from previous efforts to support advisory encounters, in which the interaction suffered from the presence of a tool [33, 44, 70], despite the fact that the tools used in the past were providing a shared screen [33, 46], enhanced lower level aspects as knowledge transfer [34] or transparency [58]. The informants identify multiple aspects of the design that differentiate LivePaper from conventional advisory service and they assess their contribution towards service quality improvement. Table 2 summarizes the design themes identified as most important for improving the service experience while linking them to the previous studies from the mixed reality and advisory services domains.

Table 2. Design themes relevant for supporting service interaction along with inspiration from mixed reality research and previous literature on supporting advisory services

| *LivePaper Design Themes* | *Related themes in Mixed Reality* | *Related themes in Advisory Services* |
|---|---|---|
| 1 (Visualize): *Introduce dynamic visualizations of relevant matters in form of graphs and diagrams to support understanding and transparency.* | Tangibles for learning [52, 69] and connecting information [48, 49] | Transparent advice via visualization [58] and value manipulation [34] |
| 2 (Structure): *Support conventional paper handling to allow for clear cut points between activities.* | Paper windows [38] Spatial AR [8] | Paper practices for structuring the process [20] |
| 3 (Entice): *Introduce tokens with sentimental value to include personal topics in conversation and impress the client.* | Tangibles for fun [82] and joint focus [69] | Increasing joy via personal content [56] |
| 4 (Write and Speak): *Support natural (pen) input to prevent disturbing effects of typing on the flow of the dialogue.* | Pen-and-paper user interfaces [74, 75] | Disturbing advisory flow when typing [44] |

The fact that service encounter interaction relies on standard material like paper has implications for designing appropriate systems. Most people expect an advisor who takes notes and listens carefully, and LivePaper can provide this experience. It includes pen and paper, i.e., tools frequently used in advisory services. Natural, expected interaction allows for turning the advisor's attention to the content and away from the technology itself. Past systems for advisory services struggled with software and/or hardware receiving too much attention or significantly changing the interaction between the advisor and the advisee [44–46, 70]. Following the lines of calm design [79] allowed for pushing the system away from focus. It gets noticed by clients, however, and they attribute the better dialogue to the natural input mechanisms in combination with calculations in the background. Previous designs using pen-and-paper user interfaces [74, 75] produced similar effects in domains other than service interaction. We claim that affording natural input methods contributes to reducing the cognitive load on the advisor's side and consequently prevents the system from disturbing the advisory service [44]. Consequently, we identify *"Write and Speak"* (Table 2, Point 4) as a key theme for designing successful technology for service encounters.

Additionally, advisors are free to choose which modules or functionalities to use – the choice remains implicit though: taking the pad with a piece of paper and writing on it launches the handwriting recognition feature, positioning a marked sheet in the middle of the table launches recognition of related gestures and adequate visualization, putting a token on the table launches the associated application. However, there is no requirement to take these steps in a prescribed order. This is central for the advisors' feeling of control [58, 70]: since there is neither a visible process representation, nor a strict sequence to be followed, disturbing coercion effects could be prevented [45, 46]. At the same time, the system affords clear and noticeable signals for switching between the activities: the advisor can move one paper out and the next in to start a new point on her internal agenda. This gives the impression of a structured, ordered service to the client, even though the structure was not imposed in the system nor explicated in the design in any way. Similar approaches were popular in other mixed reality approaches including paper windows [38] and in many implementations of spatial AR [8] – space provides a natural structure or a way to order the action, which can be leveraged for the interaction. We identify *"Structure"* (2) as a design theme relevant for the design of systems for advisory services.

There is strong evidence that LivePaper supports increased understanding of financial matters. The opinions collected from the advisees, assessment of information transparency and positive effects of LivePaper on the subscales from the Salesperson Listening instrument, provide solid evidence that the advisors' actions were accountable [24, 25], i.e., the advisees could follow and understand advisors' actions and link them to the topic of mortgage. There are two aspects that add to that connection and understanding: first, the visualization of relevant matters, e.g., representation of numerical amounts on graphs and diagrams, is assessed as clear and appealing by the advisees; second, the dynamic adaptation of the visualizations allows the advisees to understand the relationships between the numbers. This contributes to this feeling expressed by the clients that they simply could see things, which made the whole topic clearer to them – advisees report that based on the advisors' actions with LivePaper, such as using the dial ("screw"), they could establish an

even more comprehensive picture of the mortgage and its components. This feedback confirms the potential of TUIs for illustrating causal or dependency links between abstract entities [52, 69], even beyond the educational context which was extensively studied before [13, 42, 51, 69]. Also, when summarizing the encounter, many advisors positioned all used tangibles and pieces of paper with their respective graphics in the middle of the table. Opinions from the advisees make clear that they liked this gesture, because it again created an overview and brought the information together. Given the promising results related to learning in advisory encounters based on sensory experience [34], we argue that employing tangible interaction in connection with dynamic graphics is essential for effective and transparent information transfer in an advisory service, as expressed in the theme *"Visualize"* (1).

Finally, tangibles formed in a playful manner were able to spark involvement. The advisees report on the pleasure that they experienced when the advisor investigated the location of 'their' future property and describe this as a very personal, engaging interaction. Accordingly, tangibles not only represent specific concepts, but also generate involvement [82] and attract collaborators' focus [69]. Since involvement plays a central role in relationship building [56], advisors were in favor of using tangibles to inspire discussion of personal topics. However, there are also clients who point out that this might be counterproductive or even deceitful, because it attracts client's attention to an irrelevant matter while turning it away from the fact-based conversation about finances. The collected data points towards the use of personally meaningful and sentimental elements in the design as a relevant theme, *"Entice"* (3).

We do not have quantitative evidence for studying the links between the identified design themes and the effects of LivePaper on the client's satisfaction with the service quality, client's perception of the interaction, and client's perception of information transparency. However, based on the literature used to derive the respective hypotheses in combination with the statements from the clients, we claim the following relationships. *"Write and Speak"* is related to the idea of supporting social conduct known from conventional services and widely shared as a social norm or ritual in advisory services also beyond the financial domain [20, 73, 77]. "*Entice"* is related to the advisor's goal to impress the client and to present oneself as a likeable and trustworthy person [20]. It gave the advisors the chance to present themselves as interested in the property and clients found this part of the conversation engaging. We claim that design decisions related to *"Write and Speak"* and *"Entice"* influenced the client's perception of the interaction (H1) as expressed by IRQ and SL measures.

The client's perception of information transparency can be linked to visualization and handling of information. *"Visualize"* is related to the potential of mixed-reality approaches to integrate dynamic visualization into material practices [48, 49, 52, 69, 74, 75] and to the previous approaches from the advisory service support domain showing the potential of collaborative technology for client education [33, 35]. *"Structure"* relies on the easy restructuring of the projected content in time and space aligned with the concepts proposed in the discourse on spatial AR [8, 38] and is related to the previous research on transparency supporting the role of structuring for perceived transparency [58]. This feature gave the advisor the chance to make structure more explicit and to signal the relationship between her actions and the visualizations. We claim that the design decision related to *"Visualize"* and *"Structure"* influenced the client's perception of information transparency (H2).

The client's satisfaction with the overall service quality (H3) as measured with BSQ and YST has a more complex character. We claim that the improvements concerning overall service quality emerge as a consequence of the combination of interpersonal and sentimental aspects, which reflect the interpersonal and marketing character of an advisory service [6, 65, 72], with the pragmatic aspects related to the regulations and guidelines driving an advisory service [41, 59, 60]. In other words, only because LivePaper's was designed in accordance with the themes listed above, it can be used to improve the overall client's satisfaction with service quality.

Overall, the strength of LivePaper resides not so much in introducing novel interaction paradigms, but in bringing together various concepts from mixed reality, combining them in a coherent manner oriented toward co-located collaboration, and adapting them to fit the advisory scenario based on previous research in this domain. Merging the mixed-reality modes with calm design generates a satisfactory experience: it allows for conducting an encounter oriented around the needs and expectations of a particular advisee and the individual practices of the advisors. Consequently, the design of LivePaper shows how combining challenges from a complex collaborative endeavor with solutions described for other domains and tested in the mixed reality domain can advance both fields.

Whereas the contributions to advisory service supporting the domain of CSCW are very broad, the mixed-reality discourse also benefits from the current study. First, this paper outlines how precise study of real-world practices can inform the design of mixed-reality technologies. Accordingly, it instantiates the general attempts made by PPUI in a specific, complex, real-world scenario [74, 75]. Second, it paves the way for new, mixed-reality solutions to be considered for other service domains like insurance advice or citizen services. While there are other careful explorations for use of mixed-reality in organizational environments, the large majority of mixed-reality research focuses on collaboration between peers (e.g., team members) [48, 49], on single-user scenarios [38, 74, 75] or on playful and experimental environments [84]. Third, the paper provides clear evidence that mixed-reality solutions, even if unusual and new to advisory services,

have the potential to improve the business value of those services. Service providers should become aware of technology paradigms going beyond the standard desktop or tablet-based tools.

### 5.2 Supporting advisory practices in service interaction

The second source of LivePaper's positive impact on advisory services lies in its practice orientation. LivePaper provides action offerings of either of two characters: First, the system affords practices and behaviors already existing in financial advisory services (e.g., positioning papers next to each other on the table for comparison). Second, it offers new behaviors aligned with the existing practices and extends them. Interestingly, both advisors and advisees express the feeling that LivePaper supports their goals and advocates their interests. Advisors say it helps them make the right impression, and advisees see advantages of better and more transparent visualizations. In fact, previous literature claims transparency to be advisees' key need when attending financial advisory services [41, 58], while making the intended impression was identified as the primary goal of the financial advisors [20].

Enhancing both dimensions simultaneously requires particular sensitivity: Enhanced transparency might compromise the advisor's efforts to make the right impression on the client, e.g., the impression that the advisor is truly interested in the client's property while in fact she does not care much. Focusing on impression management might compromise transparency, e.g., when making the impression that the house is a valuable property to sell the mortgage while in fact it is a bad investment. We claim that only by acknowledging the various rationales that shape advisory practices, will the constructed system provide the means to reach an equilibrium between the contrary motivations. If LivePaper's design enforced completely new practices and ignored the old ones, it might generate insecurity with the advisor and lead to an ineffective moderation, yielding breaks in the conversation or the ineffective behaviors presented in previous research [44, 46]. In such a situation, the advisees tend to distrust the advisor [45, 46], which negatively impacts their overall perception of the service quality. However, if LivePaper's design did not provide any opportunity to engage in new practices and simply mimicked the conventional setting, its value would be doubtful, leading to infrequent use [57].

It is essential to see practices as holistic concepts and embrace the reasons behind them. Whereas *designing for practices* [67, 80] is often taken as *designing for existing behaviors* or *designing for intended behaviors*, thus approaching surface activities, we argue that the concept needs to be understood in terms of *designing for rationales behind practices*, especially in service encounters. This follows from the character of collaborative practices as routinized behaviors [66] that implement institutional scripts and roles [27, 32, 76], as well as a person's standing concerning more general public or political discourses [71]. If the actions afforded by the system are not aligned with those rationales, the usage causes dissonance and, hence, rejection of the system. Further, if the system supports solely the existing surface behaviors – the observable actions – it may also get refused if the user feels it complicates the situation, adds complexity, or the user simply feels she can conduct the action equally well without the system. The latter may be an actual problem during the appropriation phase, when it is quite natural that users stick to their routines and try to establish an understanding of the system in relation to their routines.

Accordingly, the advisors emphasized the fact that LivePaper needs to fit their vision of an advisory service and their vision of the client. For instance, they acknowledged that streamlining the process with LivePaper was in line with their idea of how a service should be structured, but they also requested that spontaneous changes should be possible in a way so that client does not notice them, to preserve the right impression. This also includes the possibility of employing LivePaper only in specific episodes or starting with LivePaper and continuing with conventional advisory service, if preferred. LivePaper does not enforce a process – neither an abstract process postulated in literature [59] nor a process elicited through fieldwork, but provides the means for structuring the process with gestures for interacting with paper or tangibles that serve as activity shift markers. Consequently, the advisors can maintain the impression of an ordered and structured service, even if they need to improvise.

The rationale of making the right impression becomes particularly relevant in advisory services and other institutional encounters in which the user of the system, mostly the advisor, is under pressure: she wants to conduct the service in a professional and swift manner, she does not want to lose face in front of the advisee, and she may not see an added value in using a system that mimics her behavior anyway [70]. LivePaper provides support for existing behaviors, like clear activity shifts through moving material, positioning offers parallel to each other, etc. [20], but also affords new behaviors aligned with the impression-management rationale of financial advisors, such as presenting oneself as an organized person [20] or binding the client in an engaged discussion for rapport building [19, 33]. Those behaviors also facilitate a more effective transfer of knowledge to the advisee [34, 54, 58]. We claim that previous systems for financial advisory services encountered slow diffiusion because they relied on an incomplete notion of practices and ignored the conflicting rationales. Only if the system provides value to both the advisee and the advisor, is it likely to succeed.

## 6 CONCLUSION AND LIMITATIONS

Concerning the first research question (RQ1: *How does LivePaper impact the client's perception of the service?*), the current article provides evidence that LivePaper positively impacts the client's perception of service quality in three relevant dimensions. In particular, the clients experience improvements concerning information transparency, their interaction with the advisor, and overall satisfaction with service quality. This has implications for research and practice. The existing CSCW and IS discourse on supporting (financial) advisory services [33, 44, 46] receives an indication that collaborative technology can enhance the value of an encounter without generating disturbance or impacting the marketing value of an encounter. This finding has a direct link to practice: managers and advisors should revise their stance on collaborative systems in advisory services. Furthermore, mixed-reality discourse [8, 49, 74] receives a confirmation of its practicability and positive reception from its users within a dynamic, real-world context. While there have been earlier reports on successful applications of mixed-reality technologies in collaboration [7, 49, 74], the application of mixed reality in realistic, interpersonal service interactions remains rare [7, 32]. This article outlines the potential of using mixed reality in services for research and practice.

Concerning the second research question (RQ2: *Which design elements of LivePaper are relevant to the perception of service quality?*), the study identifies a range of design themes with relevance for the client's perceptions. The four design themes refer to practices employed by the advisors when they engage in paper-based services [20]. This adds to the existing CSCW and IS discourse on technology in advisory services by pointing to the importance of existing practices. This article calls for a deep embrace of existing practices or social rituals, as well as motivations behind them, as a basis for the development of technology for institutional talk settings. The design activities should be oriented toward supporting and extending work practices rather than replacing them. This finding has implications for designers and developers of technology for the frontline: even though the transactional or processual aspects of a service encounter might dominate in their descriptions or formalizations, the social and material rituals are what those encounters are made of. Mixed reality offers a way to acknowledge the socio-material nature of human encounters, but simply "mimicking" users' activities might be not enough. Only with a well-grounded understanding of what drives the user (e.g., intention to make the right impression), can the mixed-reality design provide adequate affordances. In particular, mixed-reality research tends to focus on the material aspect of collaboration but leaves out the impact on social issues [7]. The identified design themes provide links between material conduct (paper handling, input, tokens) and social meaning (impression, activities or dialog flow).

The results do not come without limitations. Clearly, the system still lacks many functionalities and flexibilities necessary for application beyond the scenario of a first encounter about a mortgage. Therefore, extending the functionality and testing the system in other advisory encounters, within and outside the financial domain, would be necessary for generalizing purposes. Furthermore, a longitudinal field study, in which the advisors use the system in their daily work (as opposed to the design experiment we conducted), could provide further insights and confirm the value of LivePaper-supported advice in the real world.

This further study could also strengthen the external validity of the evaluation. In fact, the system has been installed in three branches of the bank upon request from the advisors, and the first data on integration into day-to-day practice is being collected. The small $n$ of test participants allows for observation of strong effects only where all subjects exhibit the same tendency. Enhancing the $n$ and varying the scenario even further could confirm the observed effects, point to weaker ones, and provide further insights about the applicability of LivePaper in the envisioned domain. The presented experiment compares LivePaper treatment with the conventional one, i.e., one that represents the status-quo in the MoBa. Comparing LivePaper against advisory services supported with other systems (be it the niche, off-the-shelf products or research prototypes) would necessarily produce more insightful results; however, market research and benchmarking was beyond the scope of this project. Overall, the limitations are typical for design-oriented research.

In summary, the current study offers a major improvement concerning the support of advisory services in financial institutions and beyond. We claim that LivePaper can be used as a framework for further, focused applications addressing more specific challenges in the advisory scenario without the risk of disrupting the interpersonal relationship or making the encounter lack transparency, or simply be less satisfactory for the client. However, the frontline service scenario bears potential for further CSCW research: Artificial intelligence is expected to change the way services are provided, yet the vision of a robot as a frontline employee is strange or inadequate for many clients. LivePaper offers a way to combine the potential of current-stage artificial intelligence (quick fact checking, generation of multiple scenarios and predictions) with a fully-fledged interpersonal encounter. In an era of self-service and robo advisors, a premium frontline experience combining human-to-human and human-to-machine collaboration might be an important asset. However, it remains unclear how clients will perceive such hybrid encounters, how the roles should be distributed between human and non-human actors, and what rituals should be supported and how. We claim that interpersonal services will not disappear, but their character will necessarily change and CSCW is predestined to go along with the transformation while attending to the effects on humans, the organization, and society.

## REFERENCES


[1] Abdullah, F., Suhaimi, R., Saban, G. and Hamali, J. 2011. Bank Service Quality (BSQ) Index: An indicator of service performance. *International Journal of Quality & Reliability Management*. 28, 5 (May 2011), 542–555. DOI:https://doi.org/10.1108/02656711111132571.

[2] Abney, P.C. and Maddux, C.D. 2004. Counseling and Technology: Some Thoughts About the Controversy. *Journal of Technology in Human Services*. 22, 3 (Jun. 2004), 1–24. DOI:https://doi.org/10.1300/J017v22n03_01.

[3] Alharthi, S.A., Spiel, K., Hamilton, W.A., Bonsignore, E. and Toups, Z.O. 2018. Collaborative Mixed Reality Games. *Companion of the 2018 ACM Conference on Computer Supported Cooperative Work and Social Computing* (Jersey City, NJ, USA, Oct. 2018), 447–454.

[4] Apte, U.M. and Vepsäläinen, A.P.J. 1993. High tech or high touch? Efficient channel strategies for delivering financial services. *J. of Strategic Information Systems*. 2, 1 (Mar. 1993), 39–54. DOI:https://doi.org/10.1016/0963-8687(93)90021-2.

[5] Azuma, R.T. 1997. A survey of augmented reality. *Presence: Teleoperators & Virtual Environments*. 6, 4 (1997), 355–385.

[6] Bennett, R. and Kottasz, R. 2012. Public attitudes towards the UK banking industry following the global financial crisis. *International Journal of Bank Marketing*. 30, 2 (Jan. 2012), 128–147. DOI:https://doi.org/10.1108/02652321211210877.

[7] Billinghurst, M., Clark, A. and Lee, G. 2015. A survey of augmented reality. *Foundations and Trends® in Human–Computer Interaction*. 8, 2–3 (2015), 73–272.

[8] Bimber, O. and Raskar, R. 2005. *Spatial augmented reality: merging real and virtual worlds*. CRC press.

[9] Bonetti, F., Warnaby, G. and Quinn, L. 2018. Augmented Reality and Virtual Reality in Physical and Online Retailing: A Review, Synthesis and Research Agenda. *Augmented Reality and Virtual Reality: Empowering Human, Place and Business*. T. Jung and M.C. tom Dieck, eds. Springer International Publishing. 119–132.

[10] Briggs, R.O., Reinig, B.A. and Vreede, G.-J. 2012. The Yield Shift Theory of Satisfaction and Its Application to the IS/IT Domain. *Integrated Series in Information Systems*. Y.K. Dwivedi, M.R. Wade, and S.L. Schneberger, eds. Springer New York. 185–217.

[11] Collins, R. 2005. Chapter 1: The program of interaction ritual theory. *Interaction ritual chains*. Princeton Univ. Press.

[12] Comes, T. and Schwabe, G. 2016. How to diminish advice discounting with mobile multimedia interventions. *Proc. European Conf. on Information Systems* (Jun. 2016).

[13] Cuendet, S., Bonnard, Q., Do-Lenh, S. and Dillenbourg, P. 2013. Designing augmented reality for the classroom. *Computers & Education*. 68, (Oct. 2013), 557–569. DOI:https://doi.org/10.1016/j.compedu.2013.02.015.

[14] van Dijk, J., van der Lugt, R. and Hummels, C. 2013. Beyond Distributed Representation: Embodied Cognition Design Supporting Socio-sensorimotor Couplings. *Proceedings of the 8th International Conference on Tangible, Embedded and Embodied Interaction* (New York, NY, USA, 2013), 181–188.

[15] Dolata, M., Agotai, D., Schubiger, S. and Schwabe, G. 2019. Pen-and-paper Rituals in Service Interaction: Combining High-touch and High-tech in Financial Advisory Encounters. *Proc. ACM Hum.-Comput. Interact.* 3, CSCW (Nov. 2019), 224:1–224:24. DOI:https://doi.org/10.1145/3359326.

[16] Dolata, M., Comes, T., Schenk, B. and Schwabe, G. 2016. Persuasive Practices: Learning from Home Security Advisory Services. (Apr. 2016), 176–188.

[17] Dolata, M., Kilic, M. and Schwabe, G. 2019. When a computer speaks institutional talk: Exploring challenges and potentials of virtual assistants in face-to-face advisory services. *Proc. Hawaii Intl. Conf. on System Sciences* (Jan. 2019).

[18] Dolata, M. and Schwabe, G. 2018. Don't be afraid! Persuasive Practices in the Wild. *J. Computer Supported Cooperative Work (CSCW)*. (2018). DOI:https://doi.org/10.1007/s10606-018-9330-4.

[19] Dolata, M. and Schwabe, G. 2017. Involvement Practices in Persuasive Service Encounter: The Case of Home Security Advice. *Proc. European Conf. on Information Systems* (Guimaraes, Portugal, 2017).

[20] Dolata, M. and Schwabe, G. 2017. Paper Practices in Institutional Talk: How Financial Advisors Impress their Clients. *Computer Supported Cooperative Work (CSCW)*. (Jun. 2017), 769–805. DOI:https://doi.org/10.1007/s10606-017-9279-8.

[21] Dolata, M. and Schwabe, G. 2019. Translation and Adoption: Exploring Vocabulary Work in Expert-Layperson Encounters. *Computer Supported Cooperative Work (CSCW)*. 28, 3–4 (Jun. 2019), 685–722. DOI:https://doi.org/10.1007/s10606-019-09358-9.

[22] Dolata, M. and Schwabe, G. 2017. Tuning in to More Interactivity – Learning from IT Support for Advisory Service Encounters. *i-com: Journal of Interactive Media*. 16, 1 (2017), 23–33. DOI:https://doi.org/10.1515/icom-2016-0042.
[23] Dolata, M., Steigler, S., Nüesch, F., Schock, U., Agotai, D., Schubiger, S., Kilic, M. and Schwabe, G. 2019. Welcome, computer! How do participants introduce a collaborative application during face-to-face interaction? *Proc. Intl. Conf. on Human-Computer Interaction - INTERACT* (2019).
[24] Dourish, P. 2001. *Where the action is: the foundations of embodied interaction*. MIT Press.
[25] Dourish, P. and Bellotti, V. 1992. Awareness and Coordination in Shared Workspaces. *Proceedings of the 1992 ACM Conference on Computer-supported Cooperative Work* (New York, NY, USA, 1992), 107–114.
[26] Drew, P. and Heritage, J. 1992. Analyzing talk at work: An introduction. *Talk at work: Interaction in institutional settings*. Cambridge Univ. Press.
[27] Drew, P. and Heritage, J. 1992. *Talk at work: interaction in institutional settings*. Cambridge University Press.
[28] Eppler, M.J. and Bresciani, S. 2013. Visualization in management: From communication to collaboration. A response to Zhang. *Journal of Visual Languages & Computing*. 24, 2 (Apr. 2013), 146–149. DOI:https://doi.org/10.1016/j.jvlc.2012.11.003.
[29] EU 2014. *European Union: Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments and amending Directive 2002/92/EC and Directive 2011/61/EU Text with EEA Relevance*.
[30] Fischer, J.E., Crabtree, A., Colley, J.A., Rodden, T. and Costanza, E. 2017. Data work: how energy advisors and clients make IoT data accountable. *Computer Supported Cooperative Work (CSCW)*. (2017), 1–30.
[31] Giesbrecht, T., Comes, T. and Schwabe, G. 2015. Back in Sight, Back in Mind: Picture-Centric Support for Mobile Counseling Sessions. *Proc. Conf. Computer Supported Cooperative Work* (2015).
[32] Heath, C. and Luff, P. 2011. Gesture and institutional interaction. *Embodied interaction: Language and body in the material world*. Cambridge University Press. 276–288.
[33] Heinrich, P., Kilic, M., Aschoff, F.-R. and Schwabe, G. 2014. Enabling relationship building in tabletop-supported advisory settings. *Proc. Conf. Computer Supported Cooperative Work and Social Computing* (Baltimore, MD, USA, 2014), 171–183.
[34] Heinrich, P., Kilic, M. and Schwabe, G. 2014. Microworlds as the locus of consumer education in financial advisory services. *Proc. Intl. Conf. on Information Systems* (Dec. 2014).
[35] Heinrich, P. and Schwabe, G. 2018. Facilitating Informed Decision-Making in Financial Service Encounters. *Business & Information Systems Engineering*. 60, 4 (Aug. 2018), 317–329. DOI:https://doi.org/10.1007/s12599-017-0501-5.
[36] Heyman, S. and Artman, H. 2015. Computer Support for Financial Advisors and Their Clients: Co-creating an Investment Plan. *Proc. Conf. Computer Supported Cooperative Work and Social Computing* (New York, NY, USA, 2015), 1313–1323.
[37] Holman, D. and Vertegaal, R. 2008. Organic User Interfaces: Designing Computers in Any Way, Shape, or Form. *Commun. ACM*. 51, 6 (Jun. 2008), 48–55. DOI:https://doi.org/10.1145/1349026.1349037.
[38] Holman, D., Vertegaal, R., Altosaar, M., Troje, N. and Johns, D. 2005. Paper windows: interaction techniques for digital paper. *Proceedings of the SIGCHI conference on Human factors in computing systems* (2005), 591–599.
[39] Hu, G., Bin Hannan, N., Tearo, K., Bastos, A. and Reilly, D. 2016. Doing While Thinking: Physical and Cognitive Engagement and Immersion in Mixed Reality Games. *Proceedings of the 2016 ACM Conference on Designing Interactive Systems* (Brisbane, QLD, Australia, Jun. 2016), 947–958.
[40] Ishii, H. 2008. The Tangible User Interface and Its Evolution. *Commun. ACM*. 51, 6 (Jun. 2008), 32–36. DOI:https://doi.org/10.1145/1349026.1349034.
[41] Jungermann, H. 1999. Advice giving and taking. *Proc. Hawaii Intl. Conf. System Sciences* (Jan. 1999), 11 pp.-.
[42] Khan, M., Trujano, F., Choudhury, A. and Maes, P. 2018. Mathland: Playful Mathematical Learning in Mixed Reality. *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems* (New York, NY, USA, 2018), D108:1–D108:4.
[43] Kilic, M. 2018. *IT-unterstützte Bedarfserhebung in der Finanzberatung*. University of Zurich.
[44] Kilic, M., Dolata, M. and Schwabe, G. 2016. How IT-Artifacts Disturb Advice Giving – Insights from Analyzing Implicit Communication. *Proc. Hawaii Intl. Conf. System Sciences* (Jan. 2016), 878–887.

[45] Kilic, M., Dolata, M. and Schwabe, G. 2017. Why do you ask all those questions? Supporting client profiling in financial service encounters. *Proc. Hawaii Intl. Conf. System Sciences* (Waikoloa Beach, HI, USA, 2017).
[46] Kilic, M., Heinrich, P. and Schwabe, G. 2015. Coercing into Completeness in Financial Advisory Service Encounters. *Proc. Intl. Conf. Computer-Supported Cooperative Work and Social Computing* (Vancouver, BC, Canada, 2015), 1324–1335.
[47] Koskinen, I.K. ed. 2011. *Design research through practice: from the lab, field, and showroom*. Morgan Kaufmann/Elsevier.
[48] Luff, P., Adams, G., Bock, W., Drazin, A., Frohlich, D., Heath, C., Herdman, P., King, H., Linketscher, N., Murphy, R. and others 2007. Augmented paper: developing relationships between digital content and paper. *The disappearing computer*. Springer. 275–297.
[49] Luff, P., Pitsch, K., Heath, C., Herdman, P. and Wood, J. 2009. Swiping paper: the second hand, mundane artifacts, gesture and collaboration. *Personal and Ubiquitous Computing*. 14, 3 (Dec. 2009), 287–299. DOI:https://doi.org/10.1007/s00779-009-0253-4.
[50] Mackinger, B., Jonas, E. and Mühlberger, C. 2017. When Advisors' True Intentions Are in Question. How Do Bank Customers Cope with Uncertainty in Financial Consultancies? *Frontiers in Psychology*. 8, (2017). DOI:https://doi.org/10.3389/fpsyg.2017.01112.
[51] Malinverni, L., Maya, J., Schaper, M.-M. and Pares, N. 2017. The World-as-Support: Embodied Exploration, Understanding and Meaning-Making of the Augmented World. (2017), 5132–5144.
[52] Marshall, P. 2007. Do Tangible Interfaces Enhance Learning? *Proceedings of the 1st International Conference on Tangible and Embedded Interaction* (New York, NY, USA, 2007), 163–170.
[53] Mettler, T., Eurich, M. and Winter, R. 2014. On the Use of Experiments in Design Science Research: A Proposition of an Evaluation Framework. *Communications of the AIS*. 34, 1 (2014), 223.
[54] Mogicato, R., Stehli, E., Schwabe, G., Eberhard, M. and Nussbaumer, P. 2009. *Beratungsqualität in Banken. Was der Kunde erwartet. Was der Kunde erlebt*. Solution Providers AG.
[55] Niederhoffer, K.G. and Pennebaker, J.W. 2002. Linguistic Style Matching in Social Interaction. *Journal of Language and Social Psychology*. 21, 4 (Dec. 2002), 337–360. DOI:https://doi.org/10.1177/026192702237953.
[56] Novak, J. and Schmidt, S. 2009. When Joy Matters: The Importance of Hedonic Stimulation in Collocated Collaboration with Large-Displays. *Human-Computer Interaction – INTERACT 2009*. T. Gross, J. Gulliksen, P. Kotzé, L. Oestreicher, P. Palanque, R.O. Prates, and M. Winckler, eds. Springer Berlin Heidelberg. 618–629.
[57] Nueesch, R., Zerndt, T., Alt, R. and Ferretti, R.G. 2016. Tablets Penetrate the Customer Advisory Process: A Case from a Swiss Private Bank. *BLED Proc.* (2016), 18.
[58] Nussbaumer, P., Matter, I. and Schwabe, G. 2012. "Enforced" vs. "Casual" Transparency - Findings from IT-Supported Financial Advisory Encounters. *ACM Trans. Management Information Systems*. 3, 2 (Jul. 2012), 11:1–11:19. DOI:https://doi.org/10.1145/2229156.2229161.
[59] Oehler, A. and Kohlert, D. 2009. Financial Advice Giving and Taking—Where are the Market's Self-healing Powers and a Functioning Legal Framework When We Need Them? *Journal of Consumer Policy*. 32, 2 (Jun. 2009), 91–116. DOI:https://doi.org/10.1007/s10603-009-9099-4.
[60] Oehler, A., Kohlert, D., Jungermann, H., Reisch, L. and Micklitz, H.-W. 2010. The quality of financial investment advice for private investors: problems in the advice process and potential solutions. *Statement by the Scientific Advisory Council on Consumer and Food Policy at the Federal Ministry for Food*. (2010).
[61] Pearce, C., Trumble, S., Arnold, M., Dwan, K. and Phillips, C. 2008. Computers in the new consultation: within the first minute. *Family Practice*. 25, 3 (Jun. 2008), 202–208. DOI:https://doi.org/10.1093/fampra/cmn018.
[62] Pfister, R.A. 2012. Does the Medium Matter? An Experiment on the Impact of Collaboration on Visual Sales Sessions. *2012 16th International Conference on Information Visualisation* (Jul. 2012), 343–348.
[63] Prahalad, C.K. and Ramaswamy, V. 2004. Co-creating unique value with customers. *Strategy & Leadership*. 32, 3 (Jun. 2004), 4–9. DOI:https://doi.org/10.1108/10878570410699249.
[64] Prahalad, C.K. and Ramaswamy, V. 2004. Co-creation experiences: The next practice in value creation. *Journal of interactive marketing*. 18, 3 (2004), 5–14.
[65] Ramsey, R.P. and Sohi, R.S. 1997. Listening to your customers: The impact of perceived salesperson listening behavior on relationship outcomes. *Journal of the Academy of marketing Science*. 25, 2 (1997), 127–137.
[66] Schegloff, E.A. 1986. The Routine as Achievement. *Human Studies*. 9, 2/3 (1986), 111–151.

[67] Schmidt, K. and Bannon, L. 2013. Constructing CSCW: The First Quarter Century. *Computer Supported Cooperative Work (CSCW)*. 22, 4–6 (Aug. 2013), 345–372. DOI:https://doi.org/10.1007/s10606-013-9193-7.
[68] Schmidt-Rauch, S. 2013. *Value Co-Creation im Reisebüro der Zukunft : Gestaltung kooperativer Reiseberatung*. University of Zurich.
[69] Schneider, B., Sharma, K., Cuendet, S., Zufferey, G., Dillenbourg, P. and Pea, R.D. 2015. 3D tangibles facilitate joint visual attention in dyads. *Proceedings of 11th International Conference of Computer Supported Collaborative Learning* (2015), 156–165.
[70] Schwabe, G. and Nussbaumer, P. 2009. Why information technology is not being used for financial advisory. *Proc. European Conf. on Information Systems*. (Jan. 2009).
[71] Scollon, R. 2001. *Mediated discourse: the nexus of practice*. Routledge.
[72] Silic, M. and Ruf, C. 2018. The effects of the elaboration likelihood model on initial trust formation in financial advisory services. *International journal of bank marketing*. 36, (2018), 572–590.
[73] Stadlbauer, A. 2010. *Pencil Selling: Symbole zeichnen - sekundenschnell und professionell*. Trauner.
[74] Steimle, J. 2009. Designing pen-and-paper user interfaces for interaction with documents. *Proceedings of the 3rd International Conference on Tangible and Embedded Interaction* (2009), 197–204.
[75] Steimle, J. 2012. *Pen-and-Paper User Interfaces*. Springer Berlin Heidelberg.
[76] Svennevig, J. 2001. Institutional and conversational modes of talk in bureaucratic consultations. *Meetings at the crossroads. Oslo: Novus* (2001), 106–135.
[77] Svinhufvud, K. and Vehviläinen, S. 2013. Papers, documents, and the opening of an academic supervision encounter. *Text & Talk*. 33, 1 (2013), 139–166.
[78] Verhallen, T.M.M., Greve, H. and Frambach, R.Th. 1997. Consultative selling in financial services: an observational study of the mortgage mediation process. *intl. J. Bank Marketing*. 15, 2 (Apr. 1997), 54–59. DOI:https://doi.org/10.1108/02652329710160466.
[79] Weiser, M. and Brown, J.S. 1996. Designing calm technology. *PowerGrid Journal*. 1, 1 (1996), 75–85.
[80] Wulf, V., Rohde, M., Pipek, V. and Stevens, G. 2011. Engaging with practices: design case studies as a research framework in CSCW. *Proc. Conf. Computer Supported Cooperative Work* (2011), 505–512.
[81] Wunderlich, N.V., Wangenheim, F. v. and Bitner, M.J. 2013. High Tech and High Touch: A Framework for Understanding User Attitudes and Behaviors Related to Smart Interactive Services. *Journal of Service Research*. 16, 1 (Feb. 2013), 3–20. DOI:https://doi.org/10.1177/1094670512448413.
[82] Xie, L., Antle, A.N. and Motamedi, N. 2008. Are Tangibles More Fun?: Comparing Children's Enjoyment and Engagement Using Physical, Graphical and Tangible User Interfaces. *Proceedings of the 2Nd International Conference on Tangible and Embedded Interaction* (New York, NY, USA, 2008), 191–198.
[83] Zavolokina, L., Dolata, M. and Schwabe, G. 2016. The FinTech phenomenon: antecedents of financial innovation perceived by the popular press. *Financial Innovation*. 2, 1 (Dec. 2016). DOI:https://doi.org/10.1186/s40854-016-0036-7.
[84] Zimmerman, J. and Forlizzi, J. 2014. Research Through Design in HCI. *Ways of Knowing in HCI*. J.S. Olson and W.A. Kellogg, eds. Springer New York. 167–189.
[85] Zuckerman, O. and Gal-Oz, A. 2013. To TUI or not to TUI: Evaluating performance and preference in tangible vs. graphical user interfaces. *International Journal of Human-Computer Studies*. 71, 7 (Jul. 2013), 803–820. DOI:https://doi.org/10.1016/j.ijhcs.2013.04.003.